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Biology 3550
Physical Principles in Biology
Fall Semester 2016

Quiz 2
23 September 2016

Please write your name on each page.

Be sure to show your work and include correct units in all of your answers!

25 points total.

1. Suppose that you were to flip a (fair) coin ten times in succession and record the sequence of heads and tails.
 - (a) (3 pts) How many different sequences are possible with 10 coin flips? What is the probability of each sequence?

(b) (3 pts) What is the probability of observing exactly one heads in ten tosses?

(c) (4 pts) What is the probability of observing exactly four heads in ten tosses? (Additional space is available on the next page)

Name: _____

(d) (4 pts) If the coin is biased so that each toss has a probability of 0.6 of landing tails, what is the probability of exactly four heads in ten tosses?

2. An entomologist has been studying the foraging behavior of a newly discovered ant species. The behavior of this species appears to be rather unusual, because it moves in quite straight lines for a fixed distance of 2 cm, makes a turn of 0 to 360° (without any apparent bias), and then proceeds for another 10 cm and repeats the process.

(a) (3 pts) In what way or ways does this foraging behavior differ from that of the two ant species we discussed in class?

Name: _____

- (b) (5 pts) The entomologist has followed the walks of 6 ants for a time of 1 min each, and has recorded the overall distance (r) between the starting point and the end of each walk, as listed below:

$r(\text{cm})$
17.4
12.7
8.2
1.9
10.7
8.2

Calculate the following averages for this data set: the mean, $\langle r \rangle$, the mean-square, $\langle r^2 \rangle$, and the root-mean-square, $\text{RMS}(r)$.

- (c) (3 pts) From the data above, estimate the number of 2-cm “steps” the ants take during 1 min.